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ABSTRACT

This report defines active and passive solar energy systems, describes home uses for solar energy, and offers guidelines for choosing and installing a system. Much of the information is specific to the state of California. Uses for solar energy which are presented include passive space heating, passive cooling, active space heating, household water heating, and swimming pool heating. The following considerations in deciding whether to invest in a system are discussed: reducing the need for a system through energy conservation, determining cost effectiveness, financing the system, and claiming federal and California tax credits. Suggestions are offered for deciding whether to do it yourself or to have a contractor do the installation, for selecting a contractor, and for choosing a system. A list of sources of further information cites six energy information centers and four California energy utilities. Information in this report is current at the time of printing, August 1982, but is subject to change. (DC)

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The CIRcular™
Consumer Information Report 15

Solar Energy: Uses for Your Home

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If you've been thinking about "going solar," this report can help you decide. It explains how to put the sun to work heating your house, your household water, and your swimming pool. You'll also find information on choosing, financing, and installing a system.

You get in your car, start to sit down, and suddenly realize that the seat's too hot to sit on. You've just had a firsthand demonstration of solar energy collection, storage, and distribution. The sun's rays pass through the windows, hit the car's interior, and are transformed into heat. Some of this heat is radiated back into the air and is trapped by the window glass, raising the car's inside temperature.

While the same principles apply when using solar energy in your home, the methods used to collect and store the heat are much more efficient. A home solar energy system also distributes the heat where it's needed and regulates the temperature.

The sun's power is being used in a growing number of homes throughout the country. It may be a practical source of energy for your home as well.

Major Uses

There are two major types of solar energy systems, "active" and "passive." An active system collects and distributes the sun's heat with mechanical hardware, such as solar collectors and pumps. In a passive system, the house itself is designed to collect and store heat, which is then distributed throughout the house by natural convection (air movement) and radiation. A well-designed passive solar house will also remain comfortably cool during hot weather.

Because of the hardware they use, active systems may require more maintenance and cost more to operate than passive systems. In many cases, however, a combination of active and passive features is the most effective way to use solar energy, taking advantage of both the energy-efficient structural design of a passive system and the control over heat distribution offered by an active system.

PASSIVE SPACE HEATING Many passive solar houses have large areas of south-facing glass that let in the sun's rays. A greenhouse, a sunroom or atrium, or double-paned windows can be used for this purpose. The sun's heat is then absorbed, either by solid, heavy materials—floors or walls made of concrete or masonry, for instance—or by tubes or drums filled with water. This "thermal mass" stores the heat and radiates it into the house.

There are several different passive solar heating systems, and many passive solar homes combine more than one system. With a "direct gain" system, the house is heated both directly by sunlight passing through the living space to reach the thermal mass and by radiation from the mass. In an "indirect gain" system, the mass is placed between the south-facing glass and the living space. The sunlight first strikes the mass, which in turn heats the rest of the house.

Another type of passive solar heating, "isolated gain," uses a space attached to the main house—such as a greenhouse or atrium—for collecting and storing solar energy. The rest of the house can be heated by radiation from the thermal mass or by convection. In the latter case, windows, doors, or vents are used to control the flow of solar-heated air into the house.

The solar heat collected by the house during the day is prevented from escaping through the glass at night by some type of insulation. Where winter temperatures are fairly mild, as in much of California, double-paned glass provides sufficient insulation. Movable shutters or insulating drapes can also be used to reduce heat loss. During cold, cloudy weather, a conventional furnace or a woodstove can be used to supply additional heat.

PASSIVE COOLING In warm weather, the sun's rays are kept off the south-facing windows by overhangs, movable shutters, awnings, or deciduous trees.

In areas where the temperature drops at night, vents and windows are opened to let in the cooler outside air. The thermal mass then releases the heat absorbed during the day, and natural ventilation carries it out of the house. During the day, the cooled and shaded thermal mass absorbs any heat that enters the house through the roof and walls, keeping the interior temperature in a comfortable range.

Incorporating passive design features into a new house during the building process is the most cost-effective way to use solar energy. However, by remodeling you may be able to "retrofit" (incorporate) a passive system into your house. Depending on its design and location, you may be limited to minor improvements such as adding awnings or a south-facing window; but it may be practical to make more extensive changes, such as adding a greenhouse.

ACTIVE SPACE HEATING An active solar space heating system uses mechanical devices requiring auxiliary power to distribute and regulate heat. The sunlight is captured by "flat-plate collectors." These are shallow, black boxes that are usually "glazed"—covered with glass, fiberglass, or plastic—to reduce heat loss.

The collectors usually face toward the south and are fitted on the roof or south wall of your home, mounted on a fence, or, sometimes, placed on the ground.

Air or liquid passing through the collectors transfers the heat to where it can be either used immediately or stored. In a liquid system, the heated liquid (usually water or an antifreeze solution) is stored in an insulated

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tank. In an air system, the heated air is usually circulated through a bin filled with three to six feet of rocks (usually one to two inches in diameter), which absorb the heat. As the air or liquid cools, it is circulated back into the collectors and is heated again. Because most active solar heating systems can store only one to three days' worth of heat, they are usually backed up by a conventional heating system.

Automatic or manual controls—such as thermostats or dampers—regulate the flow of heat from storage to areas in the house. In an air system, fans blow heated air through existing ducts and registers; in a liquid system, the hot liquid is pumped through heating coils or floor pipes.

HOUSEHOLD WATER HEATING From the turn of the century until the late 1920s, solar water heating was a flourishing business in California. But as natural gas and other fuels became less expensive, the use of solar energy declined. More recently, as the cost of fossil fuels has risen, solar water heating has been regaining popularity. In California, it's proving to be a practical way to heat water. A system can often be installed in an existing home for a reasonable cost; you can even buy packaged solar water heating systems right off the shelf.

Solar water heaters are usually used to heat incoming water before it enters a conventional water heater. In the most common system, a pump circulates the water between glazed solar collectors and an insulated storage tank. When you need hot water, the solar-heated water passes through the conventional water heater, which supplies the extra heat. (Instead of a conventional water heater, some systems use heating elements in the storage tank itself to supply extra heat.)

SWIMMING POOL HEATING Heating swimming pools is one of the most popular and practical uses of solar energy. Many solar pool heating systems are now available commercially. A typical system uses unglazed flat-plate collectors; the pool itself stores the heat. In many cases, the pool filter pump can be used to circulate the water through the collectors and back into the pool. If you want to use your pool during cooler months, you may also need a backup heating system or a pool cover. In mild climates, a pool cover alone may be all you need.

FREEZE PROTECTION When water is used in an active solar energy system, some type of protection is needed, even in mild climates, to prevent the water from freezing and cracking the collector panels and pipes. If yours is a closed loop system (the water in the panels and storage tank is for circulation only, not household use), you can add an oil or antifreeze solution to prevent freezing.

Two other methods—"drain down" and "recirculation"—utilize temperature sensors. When the temperature nears freezing, the sensor either causes the water to drain out of the collectors (drain down) or activates a pump which circulates warm water from the storage tank back into the collectors (recirculation).

Investing in Sunshine

CONSERVE ENERGY FIRST You can greatly reduce your utility costs by making energy-saving home improvements such as insulating your house, installing storm windows and doors, and weatherstripping and caulking your windows. For help in determining what measures will be effective, ask your utility company if it will conduct an "energy audit"—a procedure that analyzes your home's energy use and pinpoints areas where savings can be realized.

If you're building a new home, you must follow the California Energy Commission's standards for insulation. Information about the standards is available from your local building inspection department or the Energy Commission (see page 4 for the address).

Once you've taken steps to conserve energy, you may find that you've reduced the need for a solar energy system at this time. If you choose to install one later, your home will be better prepared.

WILL IT PAY? A solar energy system won't eliminate your utility bills entirely, but an efficient system can reduce the amount you pay each month. Typically, solar heating systems are designed to handle from 50% to 90% of your heating needs. In addition, a passive solar house often stays relatively cool without air conditioning.

You will most likely see fuel savings immediately after your system is installed, but it probably will be some time before the accumulated savings equal the cost of your system. The payback period for your system depends in part on your family's heating and cooling needs, weather conditions in your area, the size of your house, and current and future utility rates. Other variables are the costs of installing and maintaining the system.

FINANCING A SYSTEM A solar energy system is a big investment for which you'll probably consider financing. Many banks, savings and loan associations, credit unions, and finance companies will make loans for solar energy systems.

If you're building a new home, the cost of a solar energy system will probably be included in your mortgage. If you're adding a system to your present home, you may be able to borrow directly from a financial institution, typically through its home improvement loan program. The lender may take a deed of trust as security for this type of loan, depending on the institution's policy and the size of the loan.

When you apply for a solar energy loan, you may be required to submit copies of the plans, specifications, and cost breakdowns for the system you're planning to install. General plans and specifications may be available from the equipment manufacturer or dealer. For detailed plans showing how your system will be installed, ask your contractor or designer.

Another possible source of financing is your utility company. Many utility companies offer insulation financing; some offer rebates and loans to help you buy and install solar equipment. In addition, some companies offer solar energy consultation services to homeowners. Ask your local utility company what programs it offers (see the "Utilities" section at the end of this report).

You may also be able to finance your solar energy system through your contractor or equipment supplier. Finance charges and repayment terms for these installment contracts are negotiated between you and the contractor or supplier.

Shop carefully for your solar energy financing; compare annual percentage rates, other credit costs, and the repayment terms. Include the finance charges when calculating the cost of installation.

TAX CREDITS Currently, you may be able to recover part of the cost of installing a solar energy system through federal and state tax credits. A tax credit is subtracted from the tax you'd ordinarily owe and can be claimed even if you don't itemize deductions. However, you must file Internal Revenue Service Form 1040 and California State Franchise Tax Board Form 540.

Federal Tax Credits You can claim an income tax credit of 40% of the cost of installing a qualifying solar energy system in your principal residence, for a maximum credit of $4,000. If you make qualified energy-conserving improvements on your present home—such as adding insulation or new storm windows—you can claim a separate federal tax credit of 15% on the first $2,000 you spend on those items, for a maximum credit of $300.

If your tax credits exceed the tax you owe for the year, the extra amount may be carried over to later tax years through 1987. Both federal tax credits apply to expenses incurred through 1985. To claim them, you must file IRS Form 5695, "Residential Energy Credit."

California Tax Credit You may also claim a California income tax credit equal to 55% of the cost of installing a qualifying solar energy system on premises you own. The maximum credit is $3,000 for each separate function the system performs. (For swimming pool and spa water systems, the credit ratios are less than 55%, but the maximum is also $3,000.) These tax credits are also available on energy conservation measures taken in connection with a solar energy system. You can claim the solar energy credit for systems and devices installed through December 31, 1983. (Instead of taking the tax credit, you can de-

preciate the cost of the system over a three-year period—that is, you can spread the cost over three years and deduct a portion on your tax return each year.)

You may also claim a credit for the cost of eligible energy conservation measures not related to a solar energy system. For residential property, the credit is 40% of the cost, including installation charges. The maximum credit allowed is $1,500 per year. It is available for tax years 1981 through 1986.

To claim a California tax credit, you must file Franchise Tax Board Form 3805L, "Statement to Support Solar Energy Credit," or Franchise Tax Board Form 3514, "Energy Conservation Credit."

If a federal energy conservation credit and a California solar energy credit are allowed on the same costs, the combined state and federal credits may not exceed the maximum California credit for solar energy systems (55%) or for energy conservation measures (40%). The California credit may have to be reduced to ensure this result.

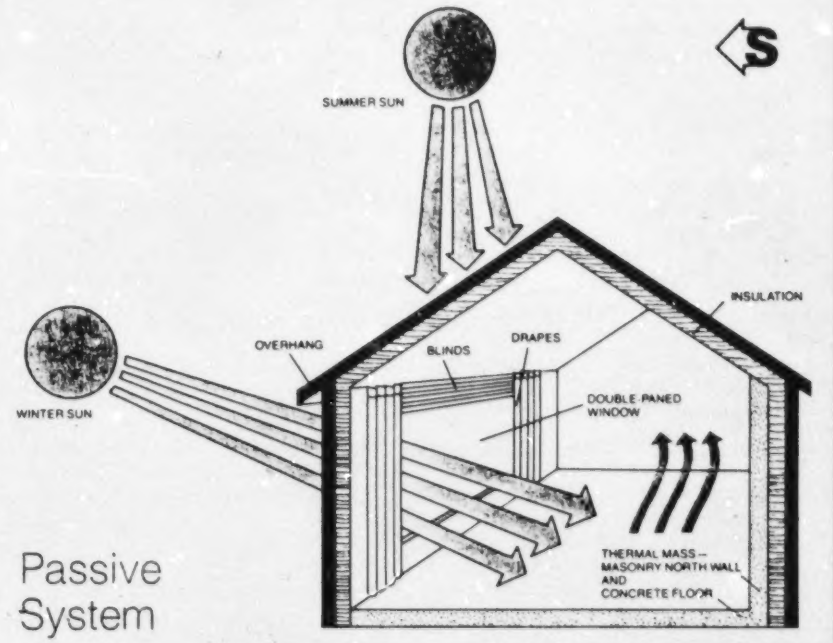
Informative Publications For more information on these tax credits, get IRS Publication 903, *Energy Credits for Individuals*, and the California Energy Commission's *Guidelines and Criteria for the California Solar Energy Tax Credit*. The latter publication also explains the technical requirements your system must meet to qualify for the state tax credit.

Cal SEAL Program For assurance that your system qualifies for the state tax credit, you can make use of the Cal SEAL (California Solar Energy Assurance Label) program. If your system meets certain technical requirements, this nonprofit consumer protection program issues a label, part of which is attached to your system and part to the tax credit form. (While this label is a good assurance that you'll receive the tax credit, the Franchise Tax Board has final authority.) The Cal SEAL program also helps resolve consumer complaints regarding systems bearing their label. For more information, contact Cal SEAL at the address listed on page 4 of this report.

Installing a System

WHO CAN DO THE WORK If you have plumbing and building skills—and the time—you might be able to install a solar water heating or swimming pool system, or some passive design features, yourself. But even if you do your own installation, you may want to have your system designed professionally to ensure that it will meet your heating needs. Installing an active space heating system and building a passive solar house probably should be left to qualified professionals.

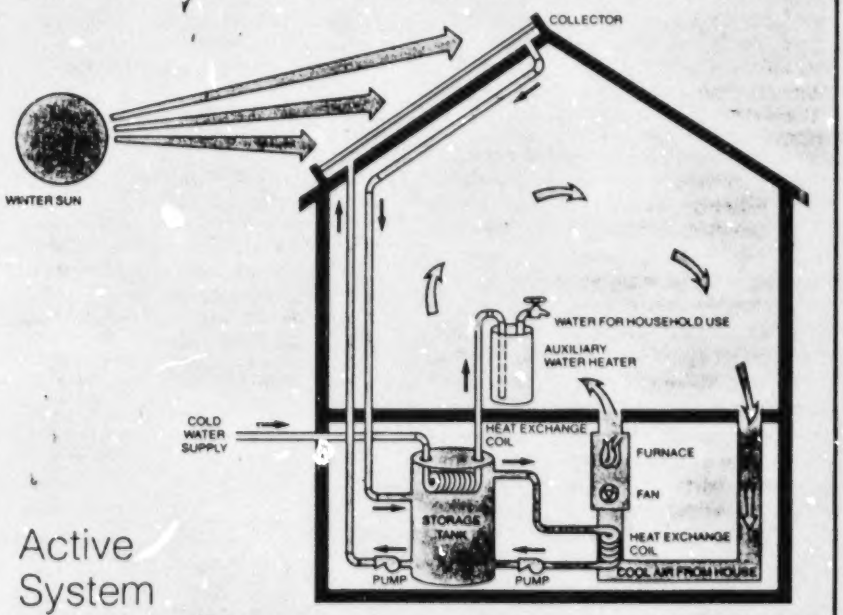
If you decide to have the work done by a contractor, you should hire one who specializes in installing the type of solar equip-



Passive System

Direct Gain Heating Double-paned windows face south to admit as much winter sunlight as possible. The thermal mass soaks up the heat, radiating it back into the house gradually. At night, the released heat is retained inside the house by the insulation and double-paned windows, or by insulating drapes.

In the summer, the overhang and blinds keep out the sun's rays during the day. Where the temperature drops at night, vents and windows are opened to cool the thermal mass; it releases the heat absorbed in the daytime, and natural ventilation carries it out of the house. During the day, the cooled and shaded thermal mass absorbs the heat entering the house, keeping the inside air relatively cool.



Active System

Water and Space Heating (liquid) When solar heat is available, the collector pump (at left of storage tank) moves liquid through the collectors and back to storage. The pump at the right of the storage tank moves liquid through the heat exchange coil to warm air going into the house. The heat exchange coil in the storage tank warms incoming household water before it's drawn into the auxiliary water heater.

ment you want. There are currently six license classifications that qualify a contractor to install either one or several types of solar energy systems: Plumbing (C-36), Swimming Pools (C-53), Hot Water Heating (C-4), Heating and Air Conditioning (C-20), General Building (B), and General Engineering (A).

To help you choose among contractors, the Cal SEAL program supplies, on request, a list of solar contractors who have passed tests for installation proficiency.

You could also have your system designed and installed by a solar equipment manufacturer whose staff includes licensed and qualified personnel. Or, an architect or engineer could design your system and hire a qualified contractor to install it.

Experienced solar professionals can be found through advertisements, telephone directories, or friends. Referrals are also made by local and regional contractors' associations, some state and federal agencies, and some industry associations. Your utility company may also distribute a list of solar manufacturers and installers.

You can check the qualifications of a contractor, designer, or architect by asking about his or her experience with solar energy systems. Also ask for the names of their customers; talking with them will give you information about the quality of the professional's work and about living with a solar energy system. If the person you're considering hiring won't release former customers' names, find out why.

Before making a final selection, get written estimates from at least two or three companies. Additional information about home improvement contracts can be found in *Planning Home Improvements*, Report #11 in this series.

CHOOSING A SYSTEM The designer of your solar energy system generally selects the components. If you're interested in a specific product or manufacturer, discuss it with the professional you hire.

If you're doing the work yourself, shop carefully for solar equipment; compare quality of construction as well as price. Get written estimates of operating costs. And, check instruction manuals for completeness and clarity.

To help you compare solar collectors and home water heating systems, various test results and certifications are available. For example, the Solar Rating and Certification Corporation (SRCC) answers mail or phone inquiries about specific products. It also publishes quarterly directories in which products are rated for thermal performance and construction quality. (See the SRCC listing on this page for the address.)

You may find it helpful to hire an engineer or a professional solar consultant to help you choose among systems and bids or to interpret test results and performance claims.

Before you purchase a system, check local building and zoning regulations. Many California cities and counties have adopted solar energy codes that set standards for the installation of storage tanks, collectors, insulation, and ductwork. If you belong to a homeowners association, make certain that your solar installation will conform to association rules on home improvements. State law prohibits any such association from placing unreasonable restrictions on the use of solar energy systems.

Warranties Your system's warranty is your best safeguard if trouble arises. Compare product warranties (also called guarantees) before you buy. To qualify for the California tax credit, your system must have at least a one-year installer's warranty (on parts and labor) and a three-year manufacturer's warranty (covering collector panels, storage tanks, and heat exchangers), and a one-year manufacturer's warranty on pumps and controls. These warranties are also required for Cal SEAL qualification.

Don't accept oral warranties. Insist on receiving, in writing, all claims about how the product will perform and how long it will last. Federal law requires that a written warranty be made available at your request.

Be sure you understand all the terms and conditions of the warranty. If the warranty requires you to return a defective part to the manufacturer for service or replacement, remember that in the case of solar collectors or a hot water tank, this could be very difficult as well as costly. Also check whether the warranty can be transferred to someone else if you sell your home.

Ask the seller to write down and sign any additional claims. A manufacturer may not have to honor warranties or claims made by someone else. If, for example, the seller claims that a product will last ten years but the manufacturer's warranty is only for three years, the manufacturer may not be liable for the seller's claims.

Try to determine whether the company you deal with is financially able to honor its warranties. If your system has a Cal SEAL label, it is insured for one year against any failure of the contractor to honor warranties on both parts and labor. Under this plan, your system will be repaired even if the contractor goes out of business. Cal SEAL also offers an additional two years' warranty insurance.

If your solar energy system breaks down and your efforts to work things out with the contractor or manufacturer do not produce results, you can contact the Energy Unit of the California Department of Consumer Affairs for help in resolving your complaint.

Remember to keep a copy of the design schematic of your system that's submitted to obtain a building permit. It will be a useful guide if repairs are required.

For More Information

INFORMATION CENTERS **Conservation & Renewable Energy Inquiry & Referral Service (CAREIRS),** P.O. Box 8900, Silver Spring, MD 20907. Tel: (800) 523-2929 (toll-free). Call for answers to technical questions and for lists of solar professionals and publications.

Solar Rating and Certification Corporation (SRCC), 1001 Connecticut Ave., NW, Suite 800, Washington, DC 20036. Tel: (202) 293-2981. SRCC answers questions about solar products and publishes a quarterly directory of solar equipment test results.

California Energy Commission, 1111 Howe Ave., Mail Station 70, Sacramento, CA 95825. Tel: (800) 952-5670 or (916) 920-7781. Contact for general solar energy information, material on tax credits, a reading list, and the free *State Energy Newsletter.*

The American Solar Energy Society, 1230 Grandview Ave., Boulder, CO 80302. Tel: (303) 492-6017. Call or write for general solar energy information. A Society chapter is the **Northern California Solar Energy Association,** P.O. Box 886, Berkeley, CA 94701. Tel: (415) 843-4306. Meetings are open to the public.

California Solar Energy Industries Association (CAL SEIA), 926 J Street, Suite 516, Sacramento, CA 95814. Tel: (916) 443-1877. Contact for basic tax credit information and information about solar professionals.

Cal SEAL, 926 J Street, Suite 514, Sacramento, CA 95814. Tel: (916) 442-6475. Contact for a list of Cal SEAL-approved solar equipment and professionals.

UTILITIES Call your local utility company for information about rebates and loans for solar water heating systems. **Pacific Gas and Electric,** Energy Conservation Center, tel: (800) 792-8000 or, in area code 805, call collect (415) 764-1600. (A list of solar manufacturers and installers is also available.) **Southern California Gas,** Energy Conservation Hotline, tel: (800) 352-4124. **Southern California Edison,** Solar Program, tel: (800) 352-8909. **San Diego Gas and Electric,** Energy Information Center, tel: (714) 232-4252, ext. 1766.

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